

NASA CR-152532

SNOWPACK GROUND TRUTH

DONNER PASS SITE
SODA SPRINGS, CALIFORNIA

January 18, 1977

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**ORIGINAL CONTAINS
COLOR ILLUSTRATIONS**

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INTRODUCTION

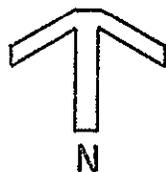
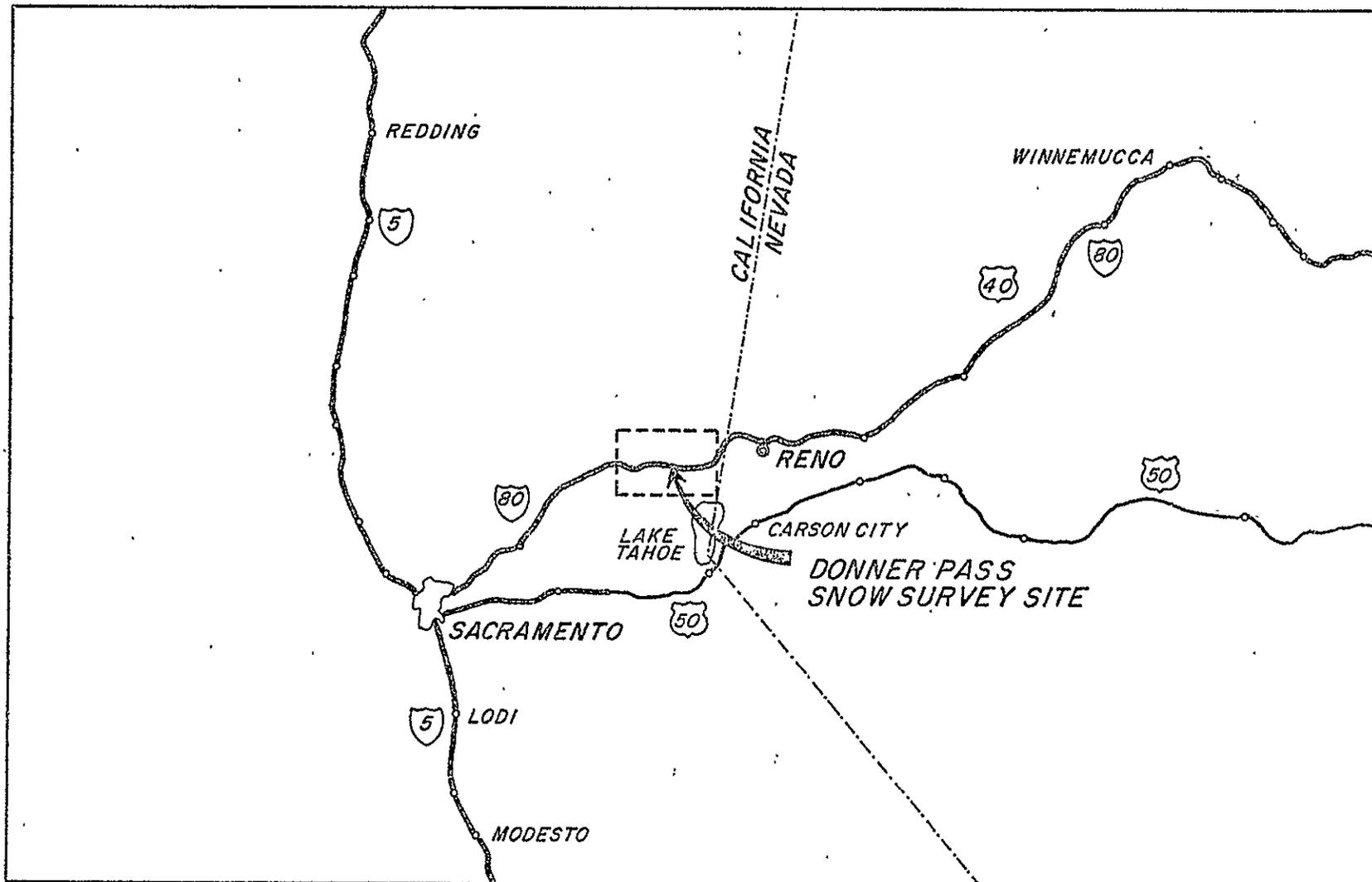
This report contains the ground-truth data taken near Soda Springs, California, on January 18, 1977, in support of the NASA Airborne Instrumentation Research Program. These data were taken by M. W. Bittinger & Associates, Inc.; personnel under the direction of Dr. E. Bruce Jones.

SITE DESCRIPTION AND GROUND-TRUTH SCOPE

The location of the Donner Pass Site, just southeast of Soda Springs, California, is shown in a general location map in Figure 1 and in detail in Figure 2. The flight line traverses much of Lake Van Norden. It should be noted that the dam on Lake Van Norden has been breached in such a manner as to prevent the storage of water. For this reason, much of the flight line passed over the former lake bed.

Ground-truth data taken in support of this mission were as follows:

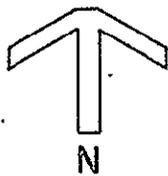
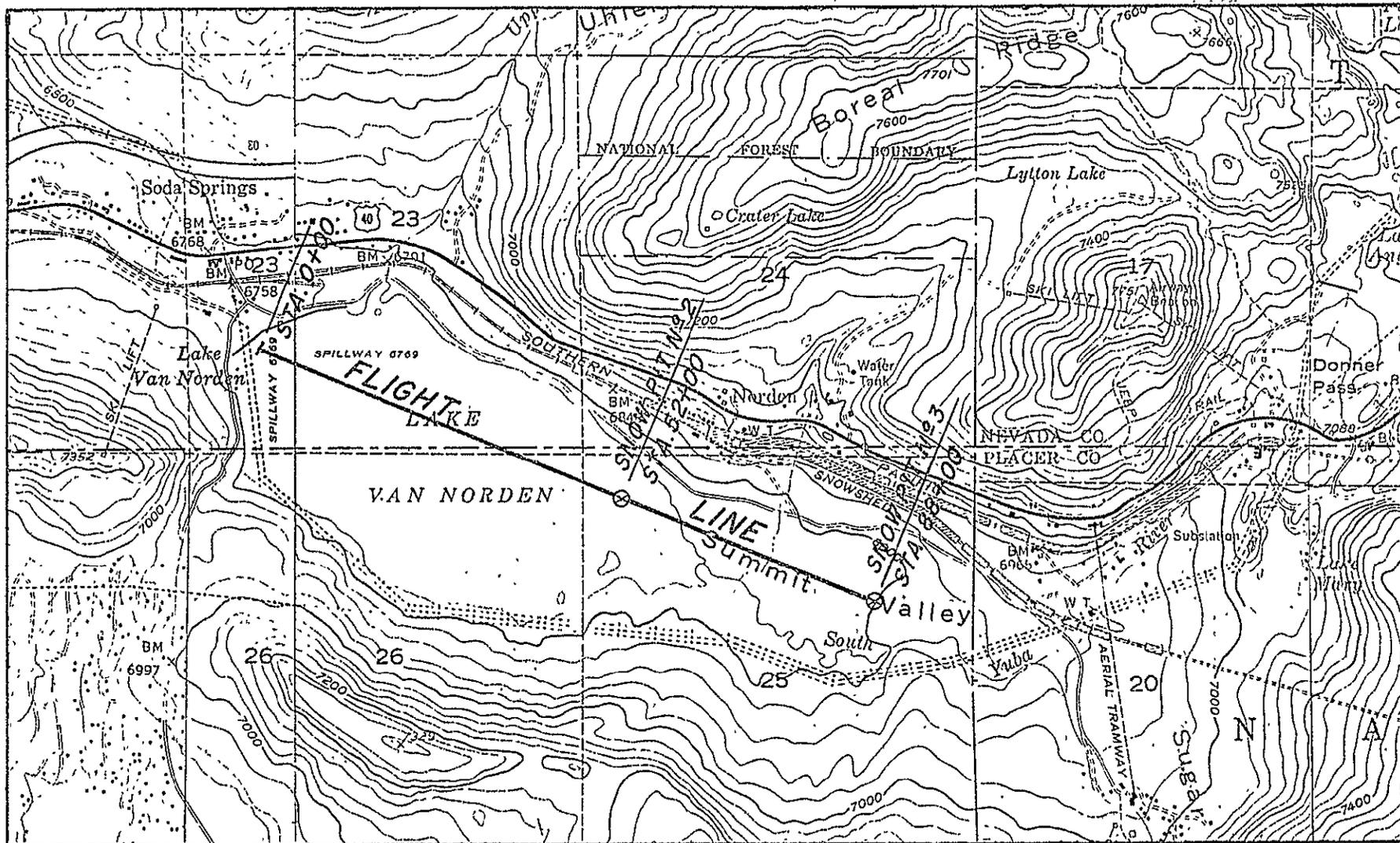
- (1) Snow depths were taken every 400 feet.
- (2) Snow densities were taken every 1200 feet.
- (3) Two snowpits were dug, and limited density, vertical layer classifications, and soil observations were taken.
- (4) Temperatures of the upper 6 inches of the snowpack were taken at one location.



SCALE: 1" = 49 MILES

Fig. 1. General location map showing Donner Pass Site.

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SCALE: 1"=2000'

Fig. 2. Detail map showing Donner Pass flight line.

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Figure 3 shows the rather typical surface roughness along the flight line.



Fig. 3. Typical snowpack roughness (note short distance variations).

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Figure 4 is a view looking back towards the starting point near the upstream toe of the dam. The flight line is just to the north of the two small trees. The tracks in the snow were made by the over-snow vehicle used in obtaining the ground truth. This vehicle was of great assistance on this particular snowpack condition.



Fig. 4. Scene looking west along flight line.

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GROUND-TRUTH DATA

Table 1 presents the snow depth and density data taken along the flight line. The locations are indicated in terms of 100's of feet from the starting point near the breach in the dam. In this table it will be noted that length of the data line is 8,800 feet as opposed to the total flight line of approximately 2.5 miles. The line was concluded at the 8,800-foot point, since beyond this one would have been in the timber. Tables 2 through 4 show the data taken in the snow pits. These pits were located along the flight line at the points indicated, again using the same indication of distance from the starting point.

The times at which data were taken are shown in all of the tables. The aircraft was overhead on its second pass at approximately 1245 hours, local time.

It should be noted that this site is quite close to the Central Sierra Snow Laboratory which is operated by the Pacific Southwest Forest and Range Experiment Station, U. S. Forest Service. This facility takes various atmospheric and snow data on a continuous basis. It should be further noted that Dr. William Linlor of NASA (Ames) was at this facility doing research on snowpack characteristics on the day of the flight. Although none of the data taken by Dr. Linlor or the Central Sierra Snow Laboratory is reported in this document; their data may be of value as it becomes available.

Table 1. Snow Depths and Densities

<u>Station</u>	<u>Depth</u> (in.)	<u>Tare</u> <u>wt.</u> (in.)	<u>Total</u> <u>wt.</u> (in.)	<u>W.E.</u> (in.)	<u>Density</u> (%)	<u>Time</u> (P.S.T.)	<u>Remarks</u>
0+00							Ice
4+00	17.0	34.5	39.2	4.7	28	1000	¼" surface crust--soft snow--dry
	17.0	34.5	39.8	5.3	31		
8+00	15.5						" " " " " "
12+00	17.3						
	17.3					1007	" " " " " "
	18.0						
16+00	17.5	34.8	37.7	2.9	17		2½-3" crust--hard then soft--dry
	close up					1020	
	17.7	35.3	38.0	2.7	15		
20+00	19.4						Slight drifting.
24+00	17.6					1030	
28+00	20.0	35.3	39.2	3.9	20	1037	Grass underneath, 1" crust--hard
	20.5	35.3	39.1	3.8	19		
32+00	21.5						4" crust--some resistance at 4"
36+00	18.0						3" crust
40+00	18.5	35.0	39.3	4.3	23	1051	2½" crust--otherwise same
44+00	19.6					1100	

Table 1 (continued)

<u>Station</u>	<u>Depth</u> (in.)	<u>Tare</u> wt. (in.)	<u>Total</u> wt. (in.)	<u>W.E.</u> (in.)	<u>Density</u> (%)	<u>Time</u> (P.S.T.)	<u>Remarks</u>
48+00	17.3					1103	Little crust
52+00	16.7	35.2	38.2	3.0	18	1110	Pit #2
56+00	18.0					1125	Crust 2-1/2"
60+00	19.9					1128	Crust 1"
64+00	19.2	35.1	39.0	3.9	20	1131	2-1/2" crust--grass
68+00	17.5					1137	In grass from here on.
72+00	15.0					1140	Twin trees at 70+00 no crust
76+00	14.0	35.1	38.7	3.6	26	1145	No crust -- in
80+00	18.1					1148	No crust
84+00	20.8					1152	
88+00	18.2	35.1	39.2	4.1	23	1200	No crust

Mean depth = 18.1 inches ^{1/}

Sample size = 22

Standard deviation = 1.83

Coef. of variation = 0.101

Mean density = 21.9% ^{1/}

Sample size = 8

Standard deviation = 4.41

Coef. of variation = 0.202

^{1/} Multiple readings taken at single point averaged and treated as single value.

Table 2. Data on Snow Pit #1

Planned for Station 4+00--unable to establish due to ice.

Moved, however, at time of flight to area west of dam and just east of railroad.

Snowpack temperatures at time of second overhead pass by NP-3 (1245 hrs. P.S.T.):

2" depth - 0°C

4" depth - 2°C

6" depth - 3°C

Second location--

2" depth - 0°C

4" depth - 2°C

6" depth - 2.2°C

Table 3. Data on Snow Pit #2

Pit #2--Station 52+00

Time--1110 hours P.S.T.

Snowpack characteristics (by Jones & Krupke)

- A. Depth - 16.7 inches.
- B. Water equivalent - 3.0 inches.
- C. Density - 18%.
- D. Horizontal density samples
 - 1. Center of tube at 2-1/2 inches
113 gms/500 cc = 0.23.
 - 2. Center of tube at 12 inches
134 gms/500 cc = 0.27.
- E. Crust, approximately 1".
Appears to be wind and possibly melt crust.
- F. Crust hardness--medium hard.
- G. Pack hardness--below crust--soft.
- H. Wetness--upper portions moist to wet, lower portion dry.
- I. Surface penetration--difficult to determine due to crust.
Footprint depth 10 to 12 inches.
- J. Snow crystals--generally less than 0.80 mm, slight metamorphism at mid-depth. No depth hoar noted.
- K. Soil--frozen solidly--dry powder when scraped, but could not be penetrated for soil moisture sample. Appears dry. No ice crystals noted.

Table 4. Data on Snow Pit #3

Pit #3--Station 88+00

Time--1200 hours P.S.T.

Snowpack characteristics (by Jones & Krupke)

- A. Depth - 18.2 inches.
- B. Water equivalent - 4.1 inches.
- C. Density - 23%.
- D. Horizontal density samples
 - 1. Center of tube at 3 inches
121 gms/500 cc = 0.24.
 - 2. Center of tube at 12 inches
148 gms/500 cc = 0.30.
- E. Crust--none apparent--area probably protected from wind by trees.
- F. Pack hardness--soft.
- G. Wetness--moist becoming wet (effect of time very noticeable).
- H. Surface penetration--footprint depth 12-14 inches.
- I. Snow crystals--generally less than 0.80 mm.
Slight metamorphosis at midpack,
noticeable liquid water at surface.
No depth hoar noted.
- J. Soil--frozen solid--unable to sample. Surface appears to have low soil moisture--no ice crystals noted.